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PESTS NOT KNOWN TO OCCUR IN THE UNITED STATES OR OF LIMITED
DISTRIBUTION, NO. 47: LARGE WHITE BUTTERFLY

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Pest LARGE WHITE BUTTERFLY
 Pieris brassicae (Linnaeus)

Selected Pontia brassicae (Linnaeus)
Synonym

Order: Family Lepidoptera: Pieridae

Economic In the United Kingdom, a loss of one percent of brassica crops
Importance due to P. brassicae resulted in a loss of about \$2.2 million
 in 1977. Where damage is more severe in countries such as
 Austria, Poland, and Sweden, crops worth many millions of
 dollars might be lost to P. brassicae. In Germany, a mass
 outbreak of larvae in the French sector of Berlin on cabbage
 and cauliflower in 1949, reached 100 per sq m. P. brassicae
 causes as much as 10 percent loss of all brassica vegetables
 each year in Czechoslovakia (Feltwell 1982). P. brassicae
 was introduced to Chile in 1971, and \$18.5 million could be
 the expected loss (Feltwell 1978).

The following factors should be considered in assessing poten-
tial damage by this pest: Infestations are often extremely
localized, and in small areas crop losses can be 100 percent;
the strong migratory habit of P. brassicae helps to disperse it
over wide areas and may help it to infest areas previously free
from infestation; the larvae can develop on a wide variety of
plants, including both cultivated and wild crucifers; popula-
tions are regulated by a large number of predators, hymenopter-
ous parasites, and micro-organisms such as viruses, bacteria,
protozoa, and fungi; and warm, dry years usually result in an
increase of this species. P. brassicae appears to be restricted
by humidity and temperatures between the winter isotherm of
-16° C to -20° C and the summer isotherm of +28° C (Feltwell
1982).

Hosts While its hosts include a variety of plant species, the success
 of P. brassicae is due to the larva being oligophagous on many
 species which contain mustard oil glycosides which act as
 feeding stimulants. The majority of the hosts belongs to
 Brassicaceae with others in the Capparaceae, Fabaceae,
 Resedaceae, and Tropalolaceae.

Brassica oleracea, Capitata Group (cabbage) is one of the most important hosts. Principal hosts are Alliaria petiolata (garlic mustard), Arabis alpina (mountain rock cress), Armoracia rusticana (horseradish), Aubrieta deltoidea, Aurinia saxatilis (basket-of-gold), Barbarea vulgaris (yellow rocket, winter-cress), Biscutella auriculata (buckler mustard), Biscutella laevigata (buckler mustard), Brassica sp. (mustard), Brassica napus (rape), Napobrassica Group (rutabaga, swede), Brassica nigra (black mustard), Brassica oleracea, Botrytis Group (broccoli, cauliflower), Capitata Group (cabbage, savoy cabbage), Gemmifera Group (brussel-sprouts), and Gongylodes Group (kohlrabi), Brassica rapa, Rapifera Group (turnip), Bunias orientalis (turkish rocket), Cakile maritima (sea rocket), Capparis sp. (caper bush), Capparis spinosa (caper), Capsella bursa-pastoris (shepherd's-purse), Cardamine hirsuta (hairy bittercress), Cardaria draba (hoary cress), Caylusea abyssinica, Cheiranthus cheiri (wallflower), Cleome spinosa (spiny spiderflower), Crambe cordifolia (colewort), Crambe maritima (seakale), Descurainia sophia (flixweed), Diplotaxis erucoides (white-wall rocket), Diplotaxis muralis (stinking wallrocket), Diplotaxis tenuifolia (slimleaf wallrocket), Draba incana (hoary whitlow-grass), Eruca vesicaria subsp. sativa (rocket-salad), Erucastrum nasturtiifolium, Erysimum hieracifolium (wall flower), Erysimum perofskianum (Afghan erysimum), Genista alba, Genista tinctoria (dyer's-green-weed), Glycine max (soybean), Hesperis matronalis (dame's rocket), Hirschfeldia incana (hoary mustard), Hornungia petraea (chamois cress), Iberis amara (rocket candytuft), Iberis gibraltarica (Gibraltar candytuft), Iberis umbellata (globe candytuft), Isatis tinctoria (woad), Kneria saxatilis, Lathyrus latifolius (everlasting pea), Lathyrus sylvestris (flat pea), Lathyrus tuberosus (earth-nut pea), Lepidium sp., Lepidium latifolium (dittander), Lepidium sativum (garden cress), Lobularia maritima (sweet alyssum), Lunaria annua (honesty), Matthiola incana (stock), Medicago sativa (alfalfa), Nasturtium officinale (watercress), Peltaria turkmena, Pisum sp. (pea), Polonisia trachysperma (clammyweed), Raphanus raphanistrum (wild radish), Raphanus sativus (radish), Reseda alba (white upright mignonette), Reseda lutea (yellow mignonette), Reseda luteola (dyer's-rocket, weld), Reseda odorata (mignonette), Reseda virgata, Rorippa sylvestris (creeping yellowcress), Satureja sp. (savory), Sinapis alba (white mustard), Sinapis arvensis (charlock), Sisymbrium officinale (hedge mustard), Sisymbrium strictissimum (rocket), Steriphoma paradoxum, Thlaspi arvense (field pennycress), Thlaspi rotundifolium (round-leaved pennycress), Tropaeolum brasiliense (nasturtium), Tropaeolum majus (nasturtium), Tropaeolum peregrinum (canary creeper), Vicia sp. (bean), and V. cracca (boreal vetch).

Secondary hosts are Allium sativum (garlic), Beta sp. (beet), Euphorbia epithymoides, Geranium sp. (geranium), Petiveria alliacea (garlic weed), and Rumex sp. (Feltwell 1982).

Additional hosts have been reported: Allium cepa (onion), Brassica rapa subsp. sarson (yellow sarson), Heracleum sphondylium (hogweed cowparsnip), Knautia arvensis (blue-buttons), Plantago tenuiflora (plantain), Taraxacum officinale (dandelion), Trifolium pratense (red clover), and Tropaeolum minus (dwarf nasturtium) (George 1927, Jegen 1919, Leonard 1948, Vats and Kaushal 1982).

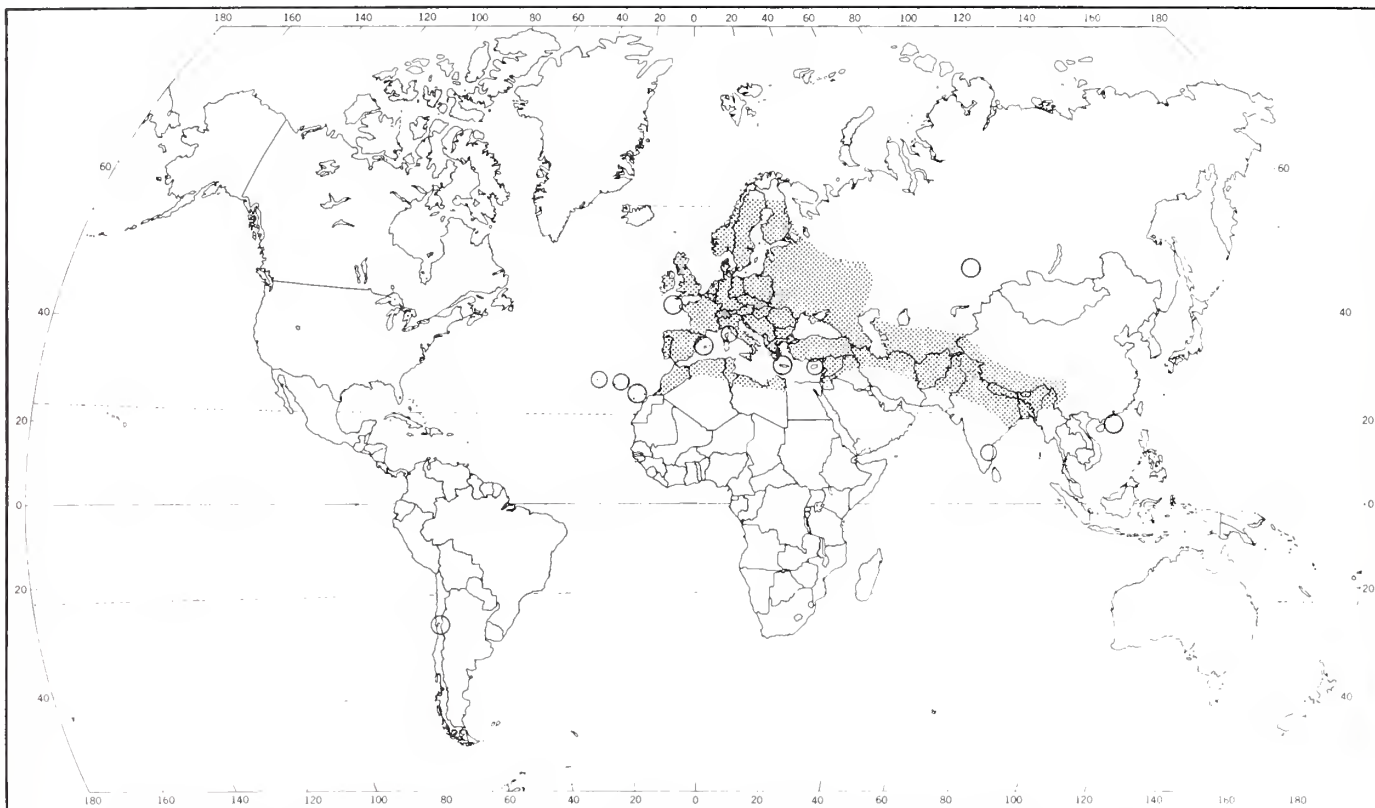
Cleome spinosa is more attractive than any other species of the Capparaceae for oviposition by P. brassicae. Five species of Reseda have been used popularly for rearing larvae. The chances of rearing P. brassicae larvae to maturity are small on Allium sp. and Petiveria sp., as the larvae do not eagerly feed on these plants (Feltwell 1982).

General Distribution

Commonwealth Institute of Entomology (1976) listed the following distribution for this species: EUROPE - Austria, Balearic Islands, Belgium, Bulgaria, Channel Islands, Czechoslovakia, Denmark, Finland, France (including Corsica), Germany, Greece (including Crete), Hungary, Ireland, Italy (including Sicily), Malta, Netherlands, Norway, Poland, Portugal (including Azores), Romania, Spain, Sweden, Switzerland, United Kingdom, and Yugoslavia; ASIA - Afghanistan, Bangladesh, Bhutan, Burma, China, Cyprus, Hong Kong, India, Iran, Iraq, Israel, Jammu and Kashmir, Jordan, Lebanon, Nepal, Pakistan, Sikkim, Syria, Tibet, and Turkey; SOVIET UNION (European part) - Georgia and Caucasus, Novosibirskaya, Armenia SSR, Kazakhskaya SSR, Kirgiskaya SSR, Lithuania SSR, Tartarskaya SSR, Tadzhikistan SSR, Turkmenskaya SSR, Uzbekskaya SSR, and Voronezhskaya SSR; AFRICA - Algeria, Canary Islands, Libya, Madeira, Morocco, and Tunisia; and SOUTH AMERICA - Chile.

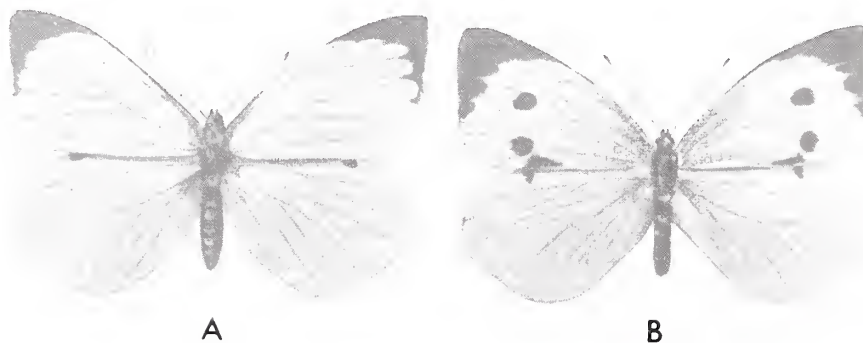
Characters

ADULTS (Fig. 1) - Body length 20 mm (Avidov and Harpaz 1969). Antennae black, tips white. Wingspan 63 mm. Wings dorsally white. Forewing tips black; hindwing front margin with black spot. Female forewing with 2 black spots, black dash on each. Spring generation markings grayish. Forewing ventrally white with yellow apex, 2 black spots; hindwing yellow. Variation uncommon, may be more black markings or cream ground color (Brooks and Knight 1982).



Pieris brassicae distribution map prepared by Non-Regional Administrative Operations Office and Biological Assessment Support Staff, PPQ, APHIS, USDA

(Fig. 1)

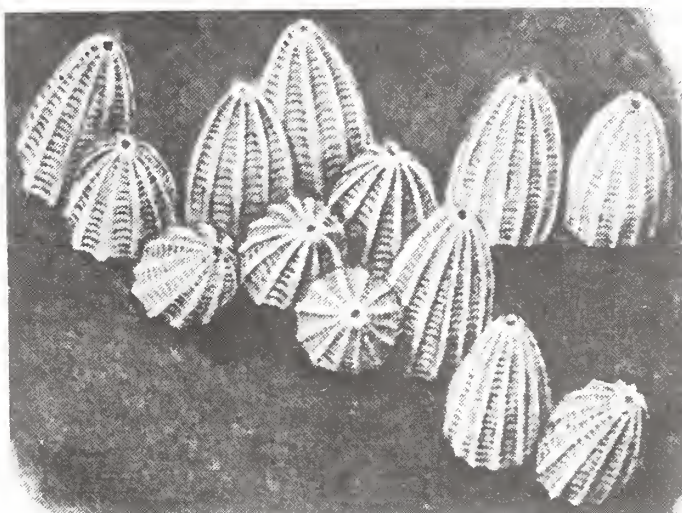


Pieris brassicae adults, dorsal view: A. Male. B. Female (From Avidov and Harpaz 1969).

Pieris brassicae resembles P. rapae (Linnaeus), imported cabbageworm, in general color and markings except P. rapae male has a black spot on the forewing. P. brassicae is larger than this species, having a wing expanse of 63 mm compared with 48 mm in P. rapae.

EGGS (Fig. 2) - Length 1.2 mm, pale yellow when newly laid, later darker, prominent longitudinal keels, fine transverse ribs (Brooks and Knight 1982).

(Fig. 2)

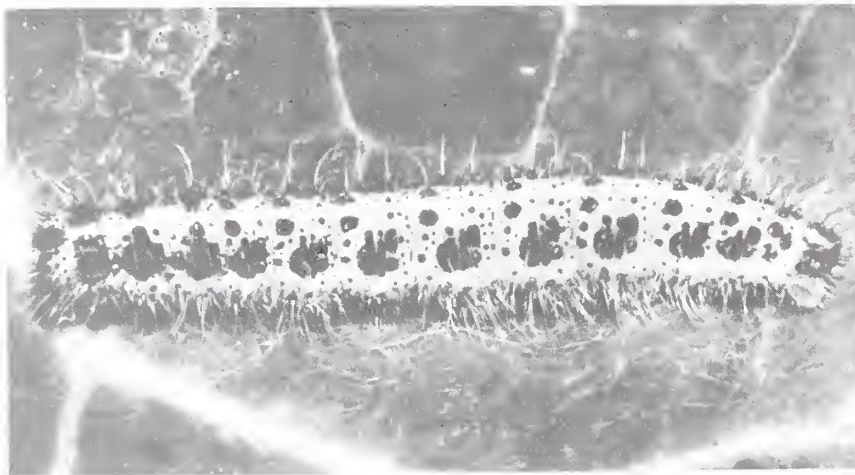


Pieris brassicae eggs, dorsal and lateral views (From Rostrup and others 1931).

Eggs of Pieris brassicae resemble eggs of P. rapae in color and markings except that eggs of P. rapae appear paler yellow than eggs of P. brassicae. P. brassicae eggs are laid in batches of 20-50 while P. rapae are laid singly or in pairs (Ministry of Agriculture, Fisheries and Food 1982a).

LARVAE (Fig. 3) - Length 40 mm. Body fawn with black patches, yellow longitudinal stripes, covered with short white hairs. First instar head black; final instar head black and gray, frons yellow (Brooks and Knight 1982, Emmett 1980).

(Fig. 3)



Pieris brassicae larva, dorsal view (From Emmett 1980).

P. brassicae larva distinguished from P. rapae larva as follows. P. brassicae fawn with black patches, yellow longitudinal stripes; P. rapae dull velvety green, minutely dotted with black, spiracular patches yellow (Ministry of Agriculture, Fisheries and Food 1982b, Ministry of Agriculture, Fisheries and Food 1982c).

PUPAE (Fig. 4) - Length 20-24 mm, width 5-6 mm, yellow brown marked with black dots (Avidov and Harpaz 1969).

Characteristic
Damage

The larvae feed on leaves from the margins inwards (Fig. 5), leaving intact the midribs (Oldham 1950). If the larvae are numerous, they can rapidly reduce leaves to skeletons (Saynor 1976). Cabbage plants sometimes have large holes gnawed between the leaf veins (Avidov and Harpaz 1969).

Detection
Notes

Movement of infested vegetables could introduce P. brassicae into a new area. Larvae may be within host vegetables, or pupae may be attached to fresh or dried vegetables or crating. Various vegetables are enterable into the United States under permit, subject to inspection.

(Fig. 4)



Pieris brassicae pupa, lateral view (From Avidov and Harpaz 1969).

(Fig. 5)



Cabbage leaf showing larvae of Pieris brassicae feeding (From Saynor 1976).

P. brassicae has been intercepted at U.S. ports of entry from France, Greece (including Crete), Italy, Portugal, Scotland, and Spain in the past 13 years. There were 42 interceptions on miscellaneous cargoes, 8 in stores, and 4 in baggage. Pupae adhering to the underside or inside of crating, can be difficult to detect. In baggage the larvae can be found with species of Brassica.

P. brassicae may be detected in the following ways.

1. Inspect for clusters of eggs near the margin of the undersurface of leaves.
2. Watch for skeletonized foliage. Note larvae clustered together on one leaf (Avidov and Harpaz 1969)
3. Inspect for pupae on walls, fences, undersills, bark of beech and chestnut, electric pylon, stones, vegetables, crates, and many other places.

Biology

Generally in the United Kingdom, on hot days the adults become active, while in chilly weather or on overcast days they rest head facing upwards (Feltwell 1982, Avidov and Harpaz 1969). They may be found in any habitat, but they are particularly attracted to gardens, both for the flowers they contain, and for the cultivated species of the cabbage family on which they lay eggs (Brooks and Knight 1982). Adults mate 1-4 days after emergence. Precopulation courtship takes place in the heat of the day, and in the cold season is limited to the afternoon hours (Avidov and Harpaz 1969). Copulation usually occurs between 20-23° C, more so at higher temperatures, but not below 15° C. The female often spends much time, fluttering around looking for a suitable leaf on which to oviposit (Feltwell 1982). Oviposition in Israel occurs when the optimum temperature is 15-18° C and the humidity is above 78 percent (Avidov and Harpaz 1969). Eggs are laid in batches on either side of the leaf, usually on the undersurface, and are often found close to the margin (Brooks and Knight 1982). In Israel, eggs averaged 26 (maximum 181) per group in 200 egg batches. The eggs hatch after 3-13 days depending on weather (Avidov and Harpaz 1969).

As the larvae emerge, they eat the egg cases, which contain vital nutrients for growth (Feltwell 1982). Afterwards they begin to nibble on the leaf (Avidov and Harpaz 1969). The larvae remain in a colony. They feed continuously and grow quickly; consequently, many larvae may be found on one leaf

(Saynor 1976). If disturbed, they produce droplets of dark green liquid from the mouth (Brooks and Knight 1982). In Israel, larval development lasts 12-50 days according to temperature. There are 3-5 larval instars (Avidov and Harpaz 1969). Full-grown larvae wander in search of a suitable pupation site. Distances traveled by wandering larvae may be considerable, up to 350 m for a mass movement in Germany (Feltwell 1982). Typical pupation sites are under copings of walls, on the top bar of fences, undersills, the bark of beech and chestnut, up an electric pylon (Feltwell 1982), plants, sticks, stones (Theobald 1928), sheds, hedgerows (Oldham 1950), weeds, and wooden poles (Avidov and Harpaz 1969). The place chosen usually offers some degree of protection against weather and predators (Feltwell 1982). The larvae attach themselves by a supporting silken girdle and tail hooks (Brooks and Knight 1982). Larvae then pupate, head upwards (Avidov and Harpaz 1969).

At 13° C in Israel, pupal development lasts 60 days, while at 27° C, pupation decreases to 7 days (Avidov and Harpaz 1969). Before eclosion the pupa makes irregular jerking movements of the abdomen thus splitting the pupal case along the proboscis line and across the back of the head. As soon as the adult has freed itself from the exuvium it climbs to a suitable position where it can expand and dry its wings (Feltwell 1982).

The first generation appears in spring and the second one in summer (Saynor 1976). Generally, the females live longer than the males, between 5-17 days depending on food, temperature, and humidity (Feltwell 1982). The complete development in Israel from oviposition to adult emergence of P. brassicae lasts 22-100 days according to the season (Avidov and Harpaz 1969).

The number of generations of P. brassicae depends on the facultative control of diapause by day length. One generation per year is typical of northern European areas, such as the Shetland Islands, Scotland and the Outer Islands, northern Ireland, the Soviet Union (Leningrad), and East Germany (Berlin); although in these areas, when summer conditions prevail, there may be two generations. During years with favorable conditions there may be up to four generations a year in central Europe. Five generations are occasionally encountered in Transcaucasia in the Soviet Union, and in Syria, Libya, and north India. Up to six generations a year are found in north Africa (Feltwell 1982).

P. brassicae is strongly migratory. It regularly migrates about 350 km from continental Europe to the United Kingdom. P. brassicae has been found migrating frequently with P. rapae and P. napi (Linnaeus) (another pierid butterfly). Usually P. brassicae fly for 5-20 m about 40 cm above the ground, frequently changing direction. On migration they fly 1.5-2.5 m for prolonged periods and do not change direction or alight. P. brassicae has been recorded flying over 6 km on the highest mountains in northwest India (Feltwell 1982).

Natural
Enemies

One of the most important and widely known parasites of P. brassicae is the braconid, Apanteles glomeratus (Linnaeus), which is a gregarious larval parasite (Feltwell 1982).

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